УДК 54.06

Студ. В.О. Харишева
Рук. Е.Ю. Серова
УГЛТУ, Екатеринбург

ГРАВИМЕТРИЧЕСКИЙ АНАЛИЗ И КОНТРОЛЬ СОСТОЯНИЯ ОКРУЖАЮЩЕЙ СРЕДЫ (GRAVIMETRIC ANALYSIS FOR ENVIRONMENTAL MONITORING)

Выделено несколько видов загрязнений: загрязнение воздуха, загрязнение воды и загрязнение почв. Гравиметрический метод применяется для мониторинга окружающей среды. Приведены примеры использования гравиметрического метода для определения содержания золота в ювелирных изделиях, концентрации твердых частиц в атмосферном воздухе и для очистки питьевой воды. Показано, что гравиметрический анализ является одним из самых точных аналитических методов.

Environmental pollution has existed for centuries but only started to be significant following the industrial revolution in the 19th century. Pollution occurs when the natural environment cannot destroy an element without creating harm or damage to itself. The elements involved are not produced by nature, and the destroying process can vary from a few days to thousands of years (that is, for instance, the case for radioactive pollutants). In other words, pollution takes place when nature does not know how to decompose an element that has been brought to it in an unnatural way. Pollution must be taken seriously, as it has a negative effect on natural elements that are an absolute need for life to exist on earth, such as water and air. Indeed, without it, or if they were present on different quantities, animals – including humans – and plants could not survive. We can identify several types of pollution on Earth: air pollution, water pollution and soil pollution. Gravimetric method is used for environmental monitoring

Therefore, the aim of this review is to discuss the gravimetric method which is used for the determination of gold in gold articles, particulate matter concentration in ambient air and for the treatment of drinking water.

Author found that gravimetry method is an alternative method for the determination of gold in gold articles. Precise and accurate measurement of gold is the primary requirement for hall marking and to trade gold internationally, as billions of dollars of gold are trading world wide for the various applications. But the method is time consuming, cumbersome and required expertise to perform the test. In the present investigation, a method has been developed gravimetry based on direct determination of gold after reducing gold in zero-valent

state by hydroxylamine hydrochloride [1]. Gravimetry is the most reliable technique and having highest metrological qualities in comparison to titremetry and instrumental method and the results of gravimetry are directly traceable to SI unit. The results of gravimetric method are accepted without reference to a standard of the same quantity. Several experiments were carried out with and without impurities and it has been concluded that gold can be determined accurately and precisely in presence of several impurities. Five replicates of approximate 0,2 g gold samples were analyzed following method proposed and percentage purity were found to be 99,993±0,0056 with 95 % confidence level (k=2). The combined uncertainty in gold measurement has also been evaluated using potential sources of the method according to the EURACHEM/GUM guidelines [2].

Author analyzed gravimetric measurement of particulate matter concentration in ambient air. This work applied a propagation of uncertainty method to typical total suspended particulate (TSP) sampling apparatus in order to estimate the overall measurement uncertainty. The objectives of this study were to estimate the uncertainty for three TSP samplers, develop an uncertainty budget, and determine the sensitivity of the total uncertainty to environmental parameters. The samplers evaluated were the TAMU High Volume TSP Sampler at a nominal volumetric flow rate of 1,42 m^3 min^{-1} (50 CFM), the TAMU Low Volume TSP Sampler at a nominal volumetric flow rate of 17 L min^{-1} (0,6 CFM) and the EPA TSP Sampler at the nominal volumetric flow rates of 1,1 and 1,7 m^3 min^{-1} (39 and 60 CFM). Under nominal operating conditions the overall measurement uncertainty was found to vary from $6{,}1 \cdot 10^{-6}$ g m^{-3} to $18{,}0 \cdot 10^{-6}$ g m^{-3}, which represented an uncertainty of 1,7 % to 5,2 % of the measurement [3]. Analysis of the uncertainty budget determined that three of the instrument parameters contributed significantly to the overall uncertainty: the uncertainty in the pressure drop measurement across the orifice meter during both calibration and testing and the uncertainty of the airflow standard used during calibration of the orifice meter. Five environmental parameters occurring during field measurements were considered for their effect on overall uncertainty: ambient TSP concentration, volumetric airflow rate, ambient temperature, ambient pressure, and ambient relative humidity. Of these, only ambient TSP concentration and volumetric airflow rate were found to have a strong effect on the overall uncertainty. The technique described in this paper can be applied to other measurement systems and is especially useful where there are no methods available to generate these values empirically.

Author analyzed drinking water and presented filtration results for drinking water treatment obtained with a commercial cellulose acetate membrane of 0,45 μm pore diameter, with and without TiO_2 coating. The deposition of titanium dioxide thin films onto membrane surface was made by pulsed-frequency d.c. reactive magnetron sputtering at room temperature from a high purity Ti target in $Ar/O_2/N_2$ atmosphere, at different conditions for cathode current and

for deposition time [2]. The proposed membranes were used in a filtration system driven by gravitation without the requirement of energy supply. The obtained results showed that the proposed system is able to remove color and turbidity from raw water. Besides, the modified membrane presented better results than the neat one regarding to membrane fouling and chlorine removal.

The results reveal that all Gravimetric analyses rely on some final determination of weight as a means of quantifying an analyte. Since weight can be measured with greater accuracy than almost any other fundamental property, gravimetric analysis is potentially one of the most accurate classes of analytical methods available. Based on the results, gravimetry method is an alternative method for the determination of gold, gravimetry method determines particulate matter concentration in ambient air, gravimetric flow system with TiO_2 coated membranes treats drinking water. The results presented here may facilitate improvements for environmental monitoring.

Bibliography

1. Gravimetric analysis. URL: http://www.chem.tamu.edu/class/majors/tutorialnotefiles/gravimetric.htm.

2. ChemistryAnalytical ChemistryGravimetric Analysis. URL: http://chemistry.tutorvista.com/analytical-chemistry/gravimetric-analysis.html.

3. Environmental Monitoring and Assessment. URL: http://www.unece.org/environmental-policy/environmental-monitoring-and-assessment/environmental-monitoring-and-assessment.html.